AUTOMATION OPERATIONS CONCEPT

1   Introduction

Due to the future reduction of operations budgets, the SOHO FOT was asked to investigate automating SOHO operations. "Lights-out" or automated operations are targeted to begin by March 07. The initial automated operations will be "night shift" operations. The final goal is to have the automation run routine operations around the clock.

The first segment will automate pass operations. Automated activities will include ground software initialization, pass activity execution, and ground software termination. The automation software will be started by the FOT or at a specified time with cron jobs. The automation will only perform the bare minimum activities to take a pass. It will handle ranging activities and MDI transitions.

The final segment will automate the remainder of routine operations. These activities include recorder management, routine daily activities, instrument load uplink, etc. Special operations such as maneuvers and contingency recovery will not be automated.

TSTOL procedures necessary for simple pass operations will be converted to run with automation. This will entail eliminating all hard WAIT statements and questions requiring realtime user input. TSTOL will key on the user ID to determine if the procedure is to be run in an automated fashion.

2   System Concept

The automation software generate a "pass plan" based on the current DSN schedule. The pass plan is simply a schedule of timed events. The pass plan will be used to generate a "pass procedure". This "temporary" TSTOL procedure will be used to initialize TPOCC, conduct all pass activities, and terminate TPOCC. This procedure will be started at scheduled times via *cron*.

After starting TSTOL, the automation software will verify successful initialization before proceeding. If any component fails, all TPOCC software will be terminated and another attempt to start it will be made. Further failures will trigger an automated alert to the FOT.

The execution of the pass procedure will be monitored to ensure successful completion. The pass procedure will include safeguards and event notifications for possible problem areas. The Automation Procedure Update Guidelines detail changes to automate TSTOL procedures.

When problems occur such as limit violations, spacecraft anomalies, or procedure execution problems, the software will make notifications and/or take corrective actions.

The notifications and actions taken will be configurable and will be based on the problem and its criticality.

As a result of non-attended operations, changes to the DSN interface will be required. For automated passes, the stations will have to come up and configure for realtime without prepass briefings. For ranging passes with reciever 1, the station will have to verify two-way communication after enabling ranging. If the ranging signal is not returned, the station will have to perform a resweep to receiver 1. The station will have to automatically reacquire telemetry after the downlink frequency shift for receiver 1 ranging passes. For non-ranging passes using receiver 2, a TBD method will be used by the DSN station to ensure two-way communication is established.

Keyhole operations will largely remain the same. Pass operations will be conducted similar to current TLM-only passes. The only change will be for 34m passes inside the 34 meter keyhole. The DSN station will have to perform the same as for reciever 1 ranging passes.

Changes are being made to the onboard software to facilitate automation. Currently, only single frame commands can be used in macros. A change has been proposed to allow for the use of COBS software and OBDH commands in macros. This will allow the use of the standard monitoring channels to change data rates and put the spacecraft in record when the uplink is lost. Additional changes being investigated are automating the 24 hour CRS drift update and wheel speed monitoring limits.

3   Spacecraft Changes

Two COBS software patches and one ACU patch were requested for facilitating automated operations. The two COBS patches were uplinked in spring 2007. The ACU patch has not been approved by ESA and no work has been done.

The first COBS patch was the automatic updating of the reaction wheel speed monitoring limits. Prior to the patch, this was manually commanded on a daily basis. The reaction wheel speed monitoring limits are updated every 24 hours by the patched software. This new function will remain enabled except during maneuvers. The RW speed limits updating function will be disabled when a latch valve is opened and re-enabled when the latch valve is closed.

The second COBS patch allows telecommand messages in macros. This patch allows greater flexibility with on-board corrective actions to standard monitoring channels. The main use of this patch for automation is the transition of the manual emergency record procedure to an automatic on-board function. In addition, the coherency commanding for receiver 1 will now be performed on-board.

The ACU patch was requested to cause the ACU to automatically perform a CRS drift calculation every 24 hours.

4 Operational Scenarios

Nominal operations – ranging pass. DSN will configure equipment in prepass without a briefing from the FOT. At AOS, the DSN station will perform the sweep into the appropriate receiver (receiver 1 for ranging passes). After the sweep is complete, the station will wait for the downlink frequency shift to ensure receiver lock. When receiver 1 is locked for 4 minutes, the standard monitoring function will enable coherency (StdMon 31) and enable standard monitoring channel 30. If this transition is not observed after 5-6 minutes, the station will attempt the sweep again. Once telemetry is acquired, the ground automation software will stop the recorder (as required) and nominal pass activities will be conducted. During the pass, a loss of lock on receiver 1 will trigger a standard monitoring channel 30 to put the spacecraft in record and enable standard monitoring channel 31.

Nominal operations - non-ranging pass. DSN will configure equipment in prepass without a briefing from the FOT. At AOS, the DSN station will perform the sweep into the appropriate receiver (receiver 2 for non-ranging passes). The DSN station will monitor for incoming commands. If commands are not received in 10 (TBC) minutes, the station will perform a resweep of receiver 2. Once receiver 2 is in lock nominal pass activities will be conducted by the ground automation software. Standard monitoring channel 32 will be enabled via time-tag command one hour after scheduled BOT. If receiver 2 lock is lost, this standard monitoring will put the spacecraft in record.